Australian Government
Australian Transport Safety Bureau

Serious injuries on board *Berge Daisetsu*

Portland, Victoria 11 January 2018

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Addendum

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Safety summary

What happened

On 11 January 2018, a team of six crewmembers was conducting cargo hold cleaning and painting under the supervision of the chief mate on board *Berge Daisetsu*. While working aloft, on a jury-rigged platform suspended from a cargo crane, the crane falling block and hook caught and then suddenly released from the hatch coaming. That resulted in shock loading of the platform and serious injuries to two crewmen.

What the ATSB found

The ATSB's investigation found that prior to starting the work, the ship's crewmembers had several discussions, made plans, and completed a risk assessment. However, the work was not conducted in accordance with company safety management procedures or industry best practice with regard to risk management and working aloft permit requirements.

Additionally, the deck crane was being operated with its working limits bypassed when used to support the ship's crew during the painting task. This enabled the crane to reach a position which allowed the block to contact and catch on the hatch coaming.

Finally, the fall arrest equipment used by the crew on the platform was incorrectly attached. As such, had either of the crewmen fallen from the platform the equipment would not have worked correctly, resulting in serious or fatal injuries.

What's been done as a result

Berge Bulk Maritime has completed the supply of approved working aloft equipment to its geared bulk carriers and is progressing modification of vessel cranes for personnel lifting. Specific working aloft and bulk carrier safety training has been conducted and made mandatory for crewmembers every two years. In addition, a fleet-wide assessment of safety maturity is progressing.

Safety message

This accident illustrates the consequence of deviating from accepted safety management procedures and industry best practice. The use of machinery and equipment contrary to its intended purpose makes hazard identification difficult and exposes those directly involved to significantly increased risk.

The occurrence

On 2 January 2018, the 180 m, geared bulk carrier *Berge Daisetsu* (Figure 1) arrived in Gladstone, Queensland, after a voyage from Long Beach, United States. The ship was carrying a cargo of petroleum coke for discharge in three Australian ports (Gladstone, Newcastle and Portland). The following voyage was to carry a cargo of grain, necessitating cleaning and inspection of the holds by a cargo surveyor before they could be certified for carriage of grain. Voyage instructions and cleaning guidance were sent to the ship prior to it arriving in Australia.

Figure 1: *Berge Daisetsu* alongside in Portland

Source: ATSB

Hold preparation

After departing Gladstone for Newcastle, New South Wales, the deck crewmembers, under the guidance of the chief mate, washed the empty cargo holds (numbers 1 and 4) with chemicals and water. A small amount of repair painting was also conducted in reachable areas. The guidance from shore management (Berge Bulk) advised that the chemical should be left on the surfaces for 30 to 45 minutes before washing down. However, in the hot conditions[1] this dwell time resulted in the chemical drying on the hold surfaces. This was in contrast to the safety management system procedures and chemical use advice to wash down before the surfaces dry.

Berge Bulk had engaged the services of a cargo surveying company to inspect the condition of the cargo holds and provide advice regarding the areas requiring attention and also the appropriate techniques to use. A surveyor inspected cargo holds 1 and 4 in Newcastle and, along with photographic appraisal by Berge Bulk shore management, determined that the holds did not meet the required standard of cleaning due, in part, to staining from the chemical used. On board discussions with the surveyor concluded that an acceptable solution was to paint the hold surfaces. However, this was not discussed with shore management, despite Berge Bulk policy and expectations that, other than touch-up painting of surfaces, hold painting was to be undertaken during drydockings.

The lower sections of each cargo hold could be painted from the hold bottom using paint rollers on extended handles. However, the upper sections needed to be accessed by other means. *Berge Daisetsu* did not have portable scaffolding equipment or dedicated suspended access (work) platforms which could be used for this task. Consequently, the master sought ideas for accessing the upper sections of the holds from those on board and discussed those options with the chief mate and bosun.

[1] Deck logbook recorded air temperatures from 25 to 32° C during this period.

Improvised work platform

The decision was made to jury-rig a portable gangway which the ship carried[2] into a work stage which could then be suspended from the cargo crane hook via slings. This plan required working aloft which in turn required procedural safeguards including a permit to work aloft, a risk assessment and tool box meetings. Furthermore, the risk assessment associated with working aloft required approval from shore management. However, in this case, this approval was not sought.

The gangway (Figure 2) comprised an approximately 0.6 m wide by 4 m long aluminium base with stanchions and rope side rails. As a gangway it was designed to be supported at its ends only, with a safe working load of 150 kg. In preparation for the painting task, the gangway was rigged with additional ropes to secure the open ends and then with slings at either end for lifting and suspending from the crane. Tag lines were connected to the underside of each end of the gangway and run to the hold bottom where they were used to control the motion of the suspended staging.

The movement of the ship while underway was considered unsuitable for this work. Consequently, the master and chief mate agreed that the painting of the upper hold areas would proceed while the ship was alongside in Portland, Victoria.

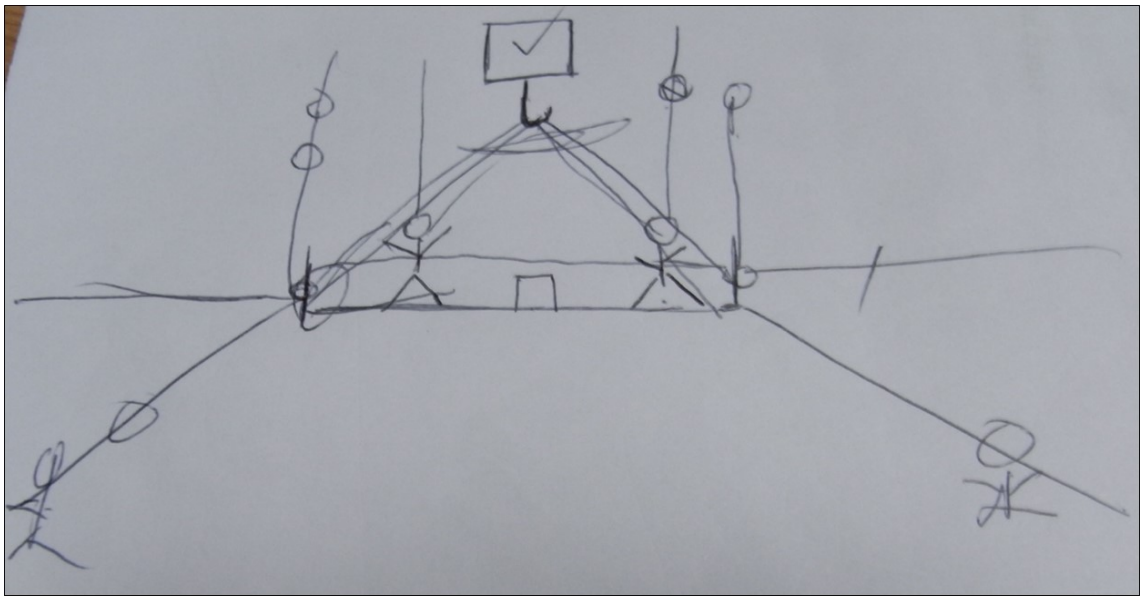
Figure 2: Portable ship's gangway as rigged for use as the suspended painting platform

Source: ATSB

[2] Under the International Convention for the Safety of Life at Sea (SOLAS), 1974, Chapter II-1, Regulation 3-9 all ships require a means of embarkation on and disembarkation from them. Guidelines for the construction, installation, maintenance and inspection/survey of such means are contained in Maritime Safety Committee circular MSC.1/Circ.1331.

The two-day sea passage from Newcastle to Portland was spent painting the lower sections of cargo holds 1 and 4 and discussing and refining the plans for painting the upper sections. The chief mate and bosun discussed the rigging and a hand sketch of how the stage would be supported was made (Figure 3).

Figure 3: Hand-drawn sketch of the work plan



Source: Berge Bulk

At 2054[3] on 10 January 2018, *Berge Daisetsu* was all fast alongside in Portland. Cargo discharge from cargo holds 2 and 5 commenced soon after and continued into the following day.

Preparation for painting

At 0800 on 11 January 2018, the chief mate held a toolbox meeting during which the painting in cargo hold number 4 was discussed. This was the first time the chief mate had undertaken hold painting on board *Berge Daisetsu* but he had done similar work on other ships using lifting equipment designed for the task.

At this meeting, the standard risk assessment for painting the upper sections of cargo hold number 4 by lifting basket (dated 11 January 2018) was worked through. The ship was not equipped with an approved lifting platform and this form did not include verification that the risk assessment had been approved by shore management as required. The working aloft permit to work for the job was discussed and completed and the chief mate signed the form as the responsible person in charge. The preparations for the work included discussion of the required personal protective equipment, use of safety harnesses, individual roles and responsibilities, communication and task details. After the incident, all involved persons stated that they were aware of the task requirements and of their duties during the task.

The deck crew gathered the necessary equipment, including the improvised work stage, guy ropes, safety harnesses, a double lanyard fall arrest safety line and painting implements (drums for the paint, paint rollers and extended handles). The work team consisted of the chief mate, in charge, the bosun, 3 able seamen (AB1, AB2 and AB3), an ordinary seaman (OS) and the deck cadet (cadet). At about 0830, they gathered on deck at the aft end of cargo hold number 4.

The bosun was tasked to drive number 4 crane to access the forward area of number 4 cargo hold and number 3 crane for the after part. He had driven cargo cranes on ships prior to *Berge*

[3] Eastern Daylight-saving Time (EDT): Universal Co-ordinated Time (UTC) + 11 hours

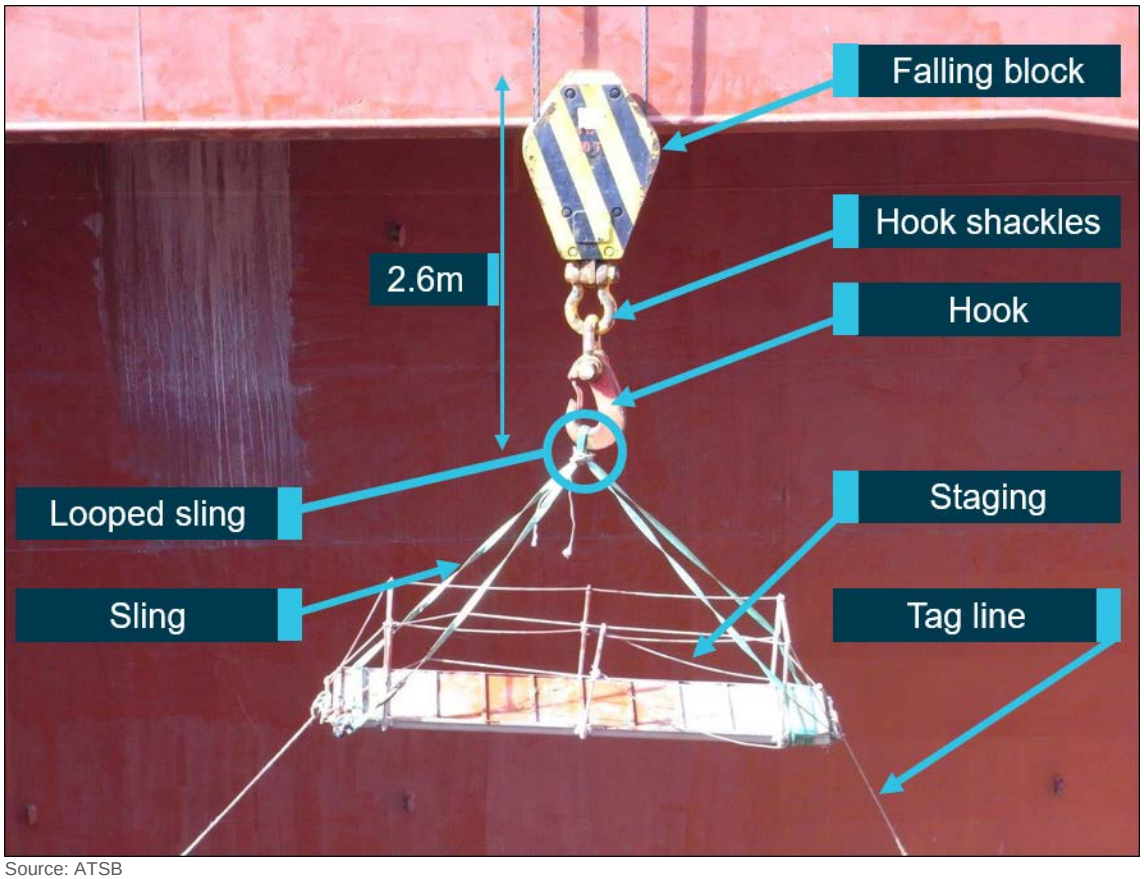
Daisetsu although this was the first time he had driven a crane for lifting personnel. None of the cranes on the ship were certified for the lifting of personnel.

The painting was to be done by AB2 and AB3, both experienced seafarers. As monitor, AB1's role was to remain on the main deck and provide assistance to, and act as lookout for, those in the hold and assist the chief mate as required.

The OS and cadet, both with less than one year's seagoing experience, were to manage the tag lines from the hold bottom, keeping the movement of the staging under control. Five radios were distributed to the chief mate, bosun, the staging crew, AB1 and to the OS.

In preparation for accessing the upper hold sections, the staging slings were placed over the hook and bound together to form a tight loop around the hook (Figure 4). AB2 and AB3, donned the safety harnesses and attached themselves one to each of the fall arrest line's lanyards. Once readied, with rollers, extended handles and 20 litre buckets for paint, the ABs boarded the staging on the main deck. The free end of the fall arrest safety line was then tied off to one of the crane hook shackles, clear of the staging slings and the hook itself. Because the improvised arrangement had limited stability, the ABs stood one at each end of the staging to balance it. They were to work from these positions and limit their movement so as to not upset the staging and equipment on board.

Figure 4: Stage and hook configuration



Source: ATSB

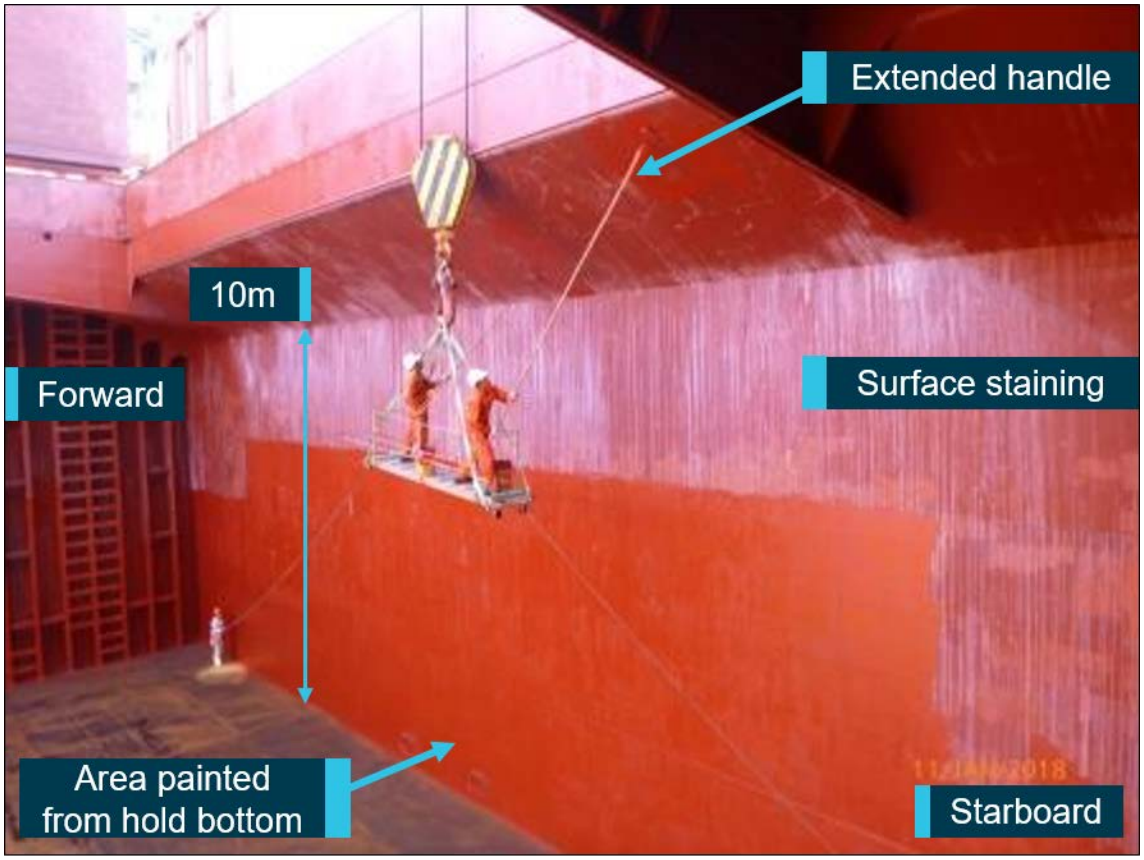
The OS and cadet held the tag lines and controlled the motion of the staging as it was lifted off the deck and lowered over the hatch coaming into hold number 4. The tag lines were then lowered into the hold and the OS and the cadet transferred from the main deck to the hold bottom. Once there, they retrieved the tag lines and maintained control of the staging as it was moved into position for the painting to commence.

Painting cargo hold 4 from the suspended work platform

Crane access into the cargo hold was limited by the edge of the hatch coaming. With the crane hoist wire against the coaming the staging hung about 4.5 m away from the hold's athwartship bulkhead. To reach the bulkhead the ABs used paint rollers fixed to extended handles. The rollers were brought back into the staging to be replenished with paint from the buckets of paint. The staging was moved into position by the bosun at the direction of AB2, via the radio. Once in the desired location, the staging was steadied by the OS and cadet using the tag lines which were then tied off to secure points in the hold (bulkhead eyes or lugs and tank lid hand holds).

The work proceeded without incident throughout the morning. On several occasions the progress of the work (Figure 5) was witnessed by the master. At 1200, the painting of the forward and starboard side areas of the hold was completed and the work team returned to the main deck and stopped for lunch.

Figure 5: Photograph, taken by the master, of work in cargo hold number 4 during the morning



Source: Berge Bulk, annotations by ATSB

During the lunch break a cargo surveyor boarded the ship to continue the earlier inspections and guidance. At about 1300 the chief mate took the surveyor to cargo hold number 4. The surveyor pointed out the remaining areas that required painting. At about 1400, the inspection of hold 4 was completed and they moved to cargo hold number 1. The chief mate asked AB1 to assist with the remaining inspection by opening number 1 hatch.

At about the same time, painting recommenced in cargo hold number 4. The jib of crane number 4 was slewed outboard and over the port side of the ship to allow sufficient room for crane number 3 to provide access to the aft coaming of cargo hatch number 4. The bosun operated crane number 3, however, in contrast to the morning's operation, this crane would not plumb over the hatch coaming within its normal operating range. In order to reach overhead the aft coaming, the

crane's lower luffing limit protection was bypassed. This was done without the knowledge of crewmembers other than the crane driver.

The incident

Utilising crane number 3, the team commenced painting on the port side aft area of the hold bulkhead in the same manner as they had earlier in the day – AB2 and AB3 boarded the staging on the main deck, it was lowered into the hold and the OS and cadet took control of the tag lines from the hold bottom (Figure 6). AB1 was on the main deck providing assistance to both the painting team and to the chief mate as required.

Figure 6: Re-enactment of the approximate staging position at the time of the incident, looking aft from the crane driver's position

Source: ATSB

By 1500 the chief mate and the cargo surveyor completed their inspection of hold number 1 and returned to the main deck, before moving aft to the accommodation and the ship's office. AB1 had moved forward to close number 1 hatch. In cargo hold number 4, the work team had moved inboard and were painting an area just to port of the centreline and about 8 m above the hold bottom. The crane falling block[4] was against the aft coaming face with the hook hanging below the coaming edge and the staging below that (Figure 7). The ABs completed the work they could reach and sought to reposition the staging further to starboard. AB2 asked the bosun to move the hook forward, horizontally, clear of the coaming, by luffing the jib up. The ABs were standing at either end of the staging with the paint buckets and rollers beside them.

At about 1510, as the bosun raised the crane jib, the falling block caught on the lower edge of the hatch coaming. This went unnoticed by the work team and, as the jib was raised further, the block suddenly came free of the coaming sending an unexpected heavy shock into the staging,

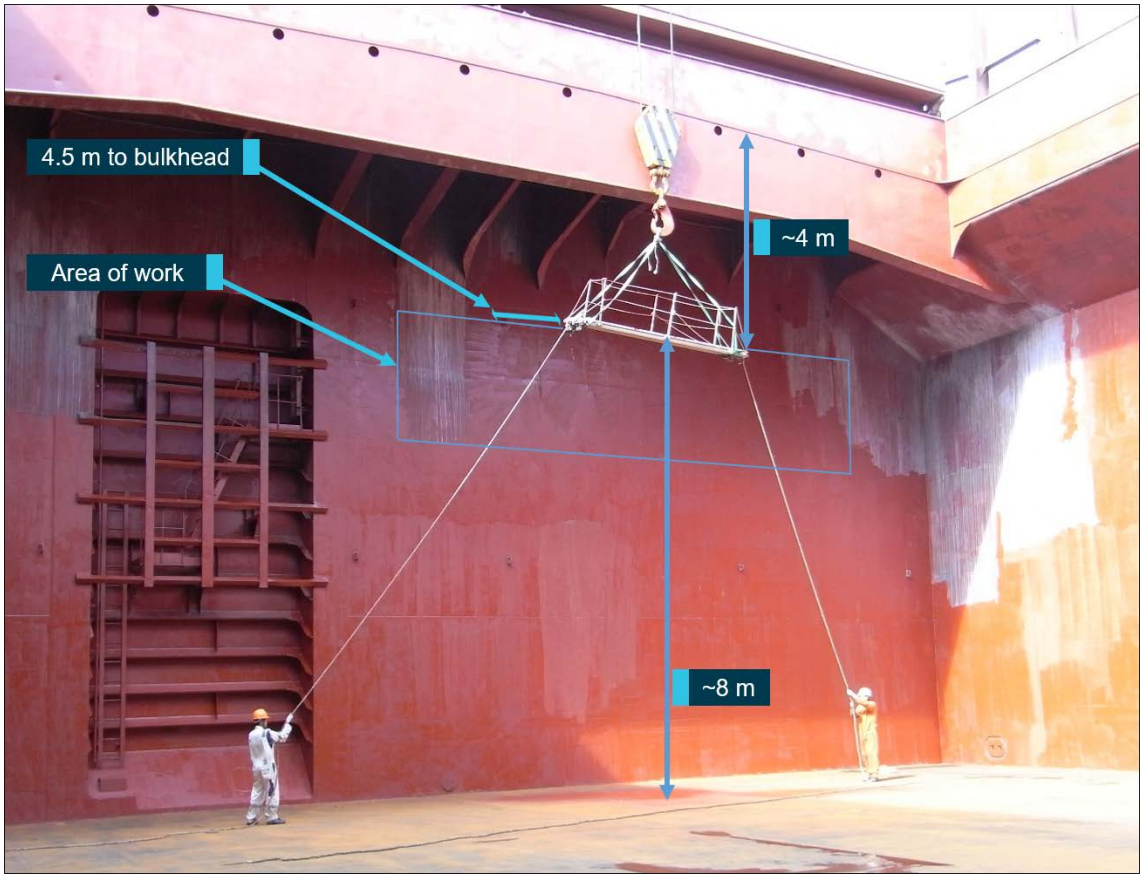
[4] Crane manufacturer terminology and also known as a travelling block.

upsetting it and its load. Both ABs were knocked over on the staging, and landed heavily on their knees and lower body. The paint buckets and rollers fell to the hold bottom.

Incident response

At the time of the incident the chief mate was on the main deck adjacent to number 5 cargo hold and AB1 was returning along the deck, adjacent to number 1 cargo hold. Both heard the sound of the falling equipment and hurried to number 4 cargo hold to investigate. The bosun stopped moving the crane and could see both ABs laying on the staging, injured. Below, the OS and cadet had avoided the falling equipment, gained control of the tag lines and stabilised the staging. After quick observation of the area, the OS radioed the bosun to lower the staging to the hold bottom so assistance could be provided to the ABs. Once on the hold bottom first aid was provided to the two injured men.

Figure 7: Re-enactment of the painting stage in the cargo hold

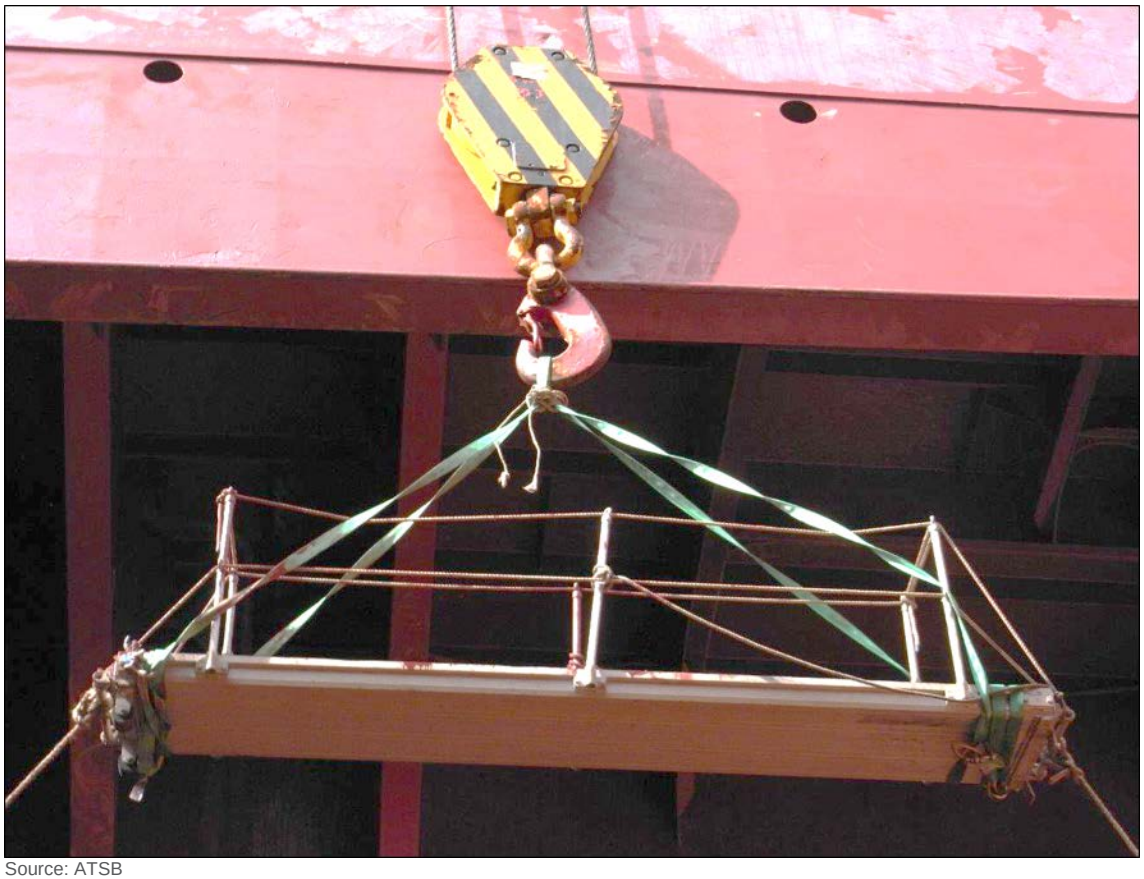


Source: ATSB

From the main deck, the chief mate radioed the master telling him of the accident and requesting immediate shore assistance. The master contacted the shore-based international medical firm contracted by the company to provide medical advice. He also notified the agent, shore authorities and company officials. He then attended the site to assess the situation. Meanwhile, an ambulance was directed to the ship and arrived alongside at about 1600. Both seriously injured men were transferred to the local hospital for assessment and further treatment.

Berge Daisetsu departed Portland bound for Wallaroo, South Australia on 14 January 2018. During the voyage the cargo holds were satisfactorily cleaned under the guidance of the cargo surveyor who travelled with the ship. Any work aloft required for the clean and touch-up repairs were discussed with, and approved by, Berge Bulk shore management. A certificate of fitness to load grain was issued on 15 January 2018 for all cargo holds.

Figure 8: Re-enactment of the approximate location of the platform and falling block at the time of the accident



Source: ATSB

Context

Berge Daisetsu

At the time of the incident, *Berge Daisetsu* was registered in the Isle of Man, owned by the Berge Daisetsu Company (Marshall Islands), and managed by Berge Bulk Maritime (Singapore). The ship was built in 2015 in Japan and classed with DNV GL.

Cargo cranes

Berge Daisetsu has five cargo holds serviced by four, Mitsubishi 30 t capacity hydraulic deck cranes – crane numbers 1 to 3 have a working radius of 24 m and number 4 (aft) crane a working radius of 26 m. The cranes were not rated or approved for personnel lifting duty.

Crewmembers

Berge Daisetsu had a crew of 21 appropriately qualified Chinese nationals including 2 cadets. The master held a Chinese certificate of competency and had joined the ship in August 2017. This was his first contract with Berge Bulk but he had sailed as master in bulk carriers since 2010.

The chief mate held a Chinese chief mate's certificate of competency and had been on board since July 2017. He first went to sea in 2007 and this was his second ship as chief mate, both were geared bulk carriers. This was the first time the chief mate had undertaken this task on board *Berge Daisetsu* but he had done similar hold painting work on other ships using lifting equipment designed for the task.

The bosun had a current Chinese certificate of proficiency as an able seafarer. He had worked at sea since 2007 and joined *Berge Daisetsu* in October 2017. This was his first time on this ship but he had driven cargo cranes on several previous occasions though this was the first time he had driven a crane for lifting personnel.

AB1 (monitor) held a Chinese certificate of competency as third officer in charge of a navigation watch and first went to sea as a deck cadet in 2014. This was his first ship with Berge Bulk and he joined *Berge Daisetsu* as an able seaman in October 2017.

AB2 (directing work from the platform) first went to sea in 2004 and held a Chinese certificate of proficiency as an able seafarer. This was his first time on board *Berge Daisetsu* and he had worked as a bosun or able seaman on several geared bulk carriers prior to joining Berge Bulk in 2016.

AB3 (assisting AB2 with painting) held a Chinese certificate of proficiency as an able seafarer. He joined *Berge Daisetsu* and Berge Bulk in October 2017 after several years' experience serving as an able seaman on general cargo ships and bulk carriers.

The ordinary seaman had been at sea since 2017 and held a Chinese certificate of proficiency for seafarers (as rating forming part of a navigational watch). *Berge Daisetsu* was his second ship, both with Berge Bulk.

The deck cadet held a Chinese certificate of proficiency for seafarers having completed basic training. He joined Berge Bulk in 2017 and *Berge Daisetsu* was his first ship.

Berge Bulk Maritime

Berge Bulk Maritime (Berge Bulk) specialises in dry bulk ships and cargoes. From a fleet of 12 vessels in 2007, Berge Bulk has grown to operate and manage a fleet of over 70 ships in 2018. The fleet includes 12 ships of less than 40,000 DWT[5] (9 owned by Berge Bulk) all fitted with deck

[5] DWT – deadweight tonnes, a measure of the mass of cargo, fuel, water, stores etc. a ship can carry.

cranes. The remainder of the fleet consists of ships of more than 170,000 DWT in size. In 2017 Berge Bulk transported over 75,000,000 t of cargo.

The latest addition to the geared bulk fleet was *Berge Snaefell* (37,800 DWT), delivered in 2018. This ship is fitted with personnel riding certified deck cranes and was delivered with class approved platforms for working aloft.[6]

Industry guidance and legislation

Legislation,[7] reflected in industry guidance, states that no lifting equipment shall be used for lifting persons unless it is designed for the purpose, except in exceptional circumstances such as for rescue or in emergencies.

At the time of the incident, *Berge Daisetsu* was flagged in the Isle of Man (IOM). The IOM Merchant Shipping Act 1985, Merchant Shipping (Code of Safe Working Practices) Regulations 1989 require that multiple copies of the current UK Maritime and Coastguard Agency (MCA) Code of Safe Working Practices for Merchant Seafarers (COSWP) are carried on board and made available to all crewmembers. COSWP references MCA Marine Guidance Notes (MGN) and UK Statutory Instruments (Regulations).[8] While the referenced MCA notices do not apply to IOM-registered vessels, it is expected that they be used as best practice guidelines. Further guidance on the standards for working and living conditions on board is provided by the IOM Merchant Shipping (Maritime Labour Convention) Regulations 2013.

Code of Safe Working Practices for Merchant Seafarers (United Kingdom Maritime and Coastguard Agency)

The MCA publication COSWP is a widely referenced nautical publication and is made available on board all Berge Bulk ships. The procedures and guidance in Berge Bulk's safety management system (SMS) relied heavily on the advice and resources available in the COSWP. If guidance or training was required on board and not covered in the SMS, the master was directed to refer to the COSWP.

The COSWP provided best practice guidance for improving health and safety on board ships. Aspects relating to the working aloft task being undertaken on board *Berge Daisetsu* were addressed in the publication. This included, but was not limited to:

- personal protective equipment (PPE) including protection from falls
- permit to work (PtW) systems
- work at height
- provision, care and use of work equipment
- lifting plant and operations including personnel lifting equipment.

Safety management system and work procedures

The Berge Bulk SMS document suite contained procedures, guidance and forms relevant to the task of hold cleaning and preparation for carriage of grain, and to the methods being employed on *Berge Daisetsu* on 11 January.

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6 Suspended work platform drawings evaluated to DNV GL standard DNVGL-ST-0378 'Standard for offshore and platform lifting appliances' in accordance with European standard EN 14502-1 'Cranes – Equipment for the lifting of persons – Part 1: Suspended baskets'.

7 Including: Isle of Man 1985, *MERCHANT SHIPPING ACT 1985, MERCHANT SHIPPING (HATCHES, HOLD ACCESS AND LIFTING PLANT), REGULATIONS 1989*, Isle of Man.

8 Including guidance notes relating to work at height (MGN 410), lifting operations and lifting equipment (LOLER, MGN 332) and the provision and use of work equipment (PUWER, MGN 331).

The SMS identified all work at a height of more than two metres above the deck as requiring a permit to work. In addition to this, risk assessments were required for cargo hold cleaning, working aloft and lifting operations with the work aloft risk assessment requiring shore management approval. Furthermore, the operation of lifting appliances was identified as a high risk task and advised that design limits were to be adhered to and safety devices working.

Relevant SMS documents for the painting task included:

- health, safety and security policy
- hold cleaning
- permit to work systems
- risk management
- working aloft
- operation of lifting appliances – a lifting appliance is one that is used for the purpose of suspending, raising, lowering or moving a load, including personnel.

Health Safety and Environmental policy

The Berge Bulk Health Safety and Environmental policy emphasised the safety of the crewmembers on board. Under this policy, the incorrect usage of any equipment was 'strictly' prohibited. On board *Berge Daisetsu*, the portable gangway (jury-rigged as the suspended work platform) was supplied to assist safe access to and from the ship. It was not intended to be used as a personnel lifting platform for cargo hold cleaning/painting.

Cargo hold cleaning

The cargo hold cleaning document stepped through stages of the inspection, cleaning and approval process. Subjects addressed included safety during cleaning, grades of hold cleaning, the use of cleaning chemicals and cargo contamination problems, including actions to minimise the contamination. The procedure dealt predominantly with cleaning and protection of paint systems and included the advice that chemicals should be washed off before they dry. Painting of surfaces was mentioned as part of damage repair, with the need to allow sufficient time for the paint to cure and harden emphasised.

Berge Bulk management advised that the crewmembers were instructed to chemically clean the cargo hold surfaces, scrubbing reachable areas only. Cleaning equipment provided for this task included high pressure water guns with a 15 m reach. After the cargo holds did not pass inspection, management expectations were that further cleaning would be required to remove the staining. This would be done at the surveyor's guidance. Painting of holds, other than minor touch-up, was usually done in dry dock after receiving inspection reports from the ship. In Berge Bulk's experience the cargo hold area most affected during cargo operations was limited to areas less than 5 m above the hold bottom. This area could be reached with equipment made available on board the ship without the need for working aloft. Consequently, the ship's crewmembers were not instructed, nor expected, to paint the upper area of cargo holds.

However, the on board discussions after the surveyor's inspection concluded that painting the hold surfaces would result in an acceptable finish, and be completed more quickly than washing and scrubbing. This would however, require accessing the upper areas of the cargo holds and thus working aloft.

Permit to work procedure

The Berge Bulk permit to work (PtW) procedure included the steps:

- assessment - including the need for a toolbox meeting and risk assessment
- authorisation – included requiring that shore approval of risk assessments, if applicable, was to be received on board prior to commencing the task

- monitoring – persons carrying out the task were to be supervised
- response to change – empowered any responsible person to stop a job if unsafe conditions were found
- closure.

Work aloft was one of the tasks identified as requiring a PtW.

The PtW procedure then listed barriers to be in place including supervision, use of safety harness and fall arrest equipment and that at least two safety barriers were to be in place.

A working aloft PtW form was completed for the task of 'Paint bulkhead by lifting basket' in hold number 4 on 11 January 2018. This form indicated that:

- a risk assessment was completed with a resultant level of risk at 2 (on a scale of 3) – the form prominently included the notice that 'whenever work is being carried out on board involving the risk of falling more than two (2) meters [sic], such work shall be considered "Working Aloft" and subjected to a risk assessment and permit-to-work.'
- equipment had been checked
- persons had been provided with safety harnesses
- other safety measures taken included the use of safety belts and safety lines
- the work and method of work had been agreed and understood
- personnel were briefed
- the chief mate was supervisor and person in charge and had signed on as person in charge as well as the person responsible for the work aloft.

The permit was approved and signed by the master.

Risk assessment procedure

The Berge Bulk SMS included a risk management procedure which had the objective to 'cover risk management and risk mitigation to ensure that protective and precautionary measures are taken, which will reduce risks associated with operation to a level that is considered to be 'as low as reasonably possible and practicable.'' One resource identified to assist users when assessing risk was to refer to the COSWP.

The risk management procedure worked through the steps to be taken including:

- hazard identification
- using the 'Take 5' – stop, think, identify, plan, proceed – technique to identify and mitigate hazards
- the procedure for completing a toolbox talk
- a list of the tasks requiring a risk assessment – this list included cargo hold cleaning, working aloft and lifting operations
- the risk assessment procedure which included referring to the relevant permit to work procedure
- a list of risk assessments requiring shore management approval prior to commencement of the associated activity, including working aloft.

A risk assessment was completed (dated 11 January 2018) for 'Working aloft - Painting cargo hold by lifting basket'. This identified several precautions to be taken to reduce the risk of harm, including:

- familiarization of the work place and surrounds prior to work commencing
- all work team members must be briefed on the work to be done and proper communications are to be maintained

- a responsible and knowledgeable person must continuously supervise and remain in communication with relevant personnel
- all equipment to be used is to be inspected and tested.

The PtW was identified as one additional precaution to be taken to reduce the risk of harm.

Contrary to the SMS requirement, this risk assessment was not provided to shore management for approval.

Operation of lifting appliances procedure

The Berge Bulk operation of lifting appliances procedure identified this as a high risk task. The procedure therefore included precautions such as:

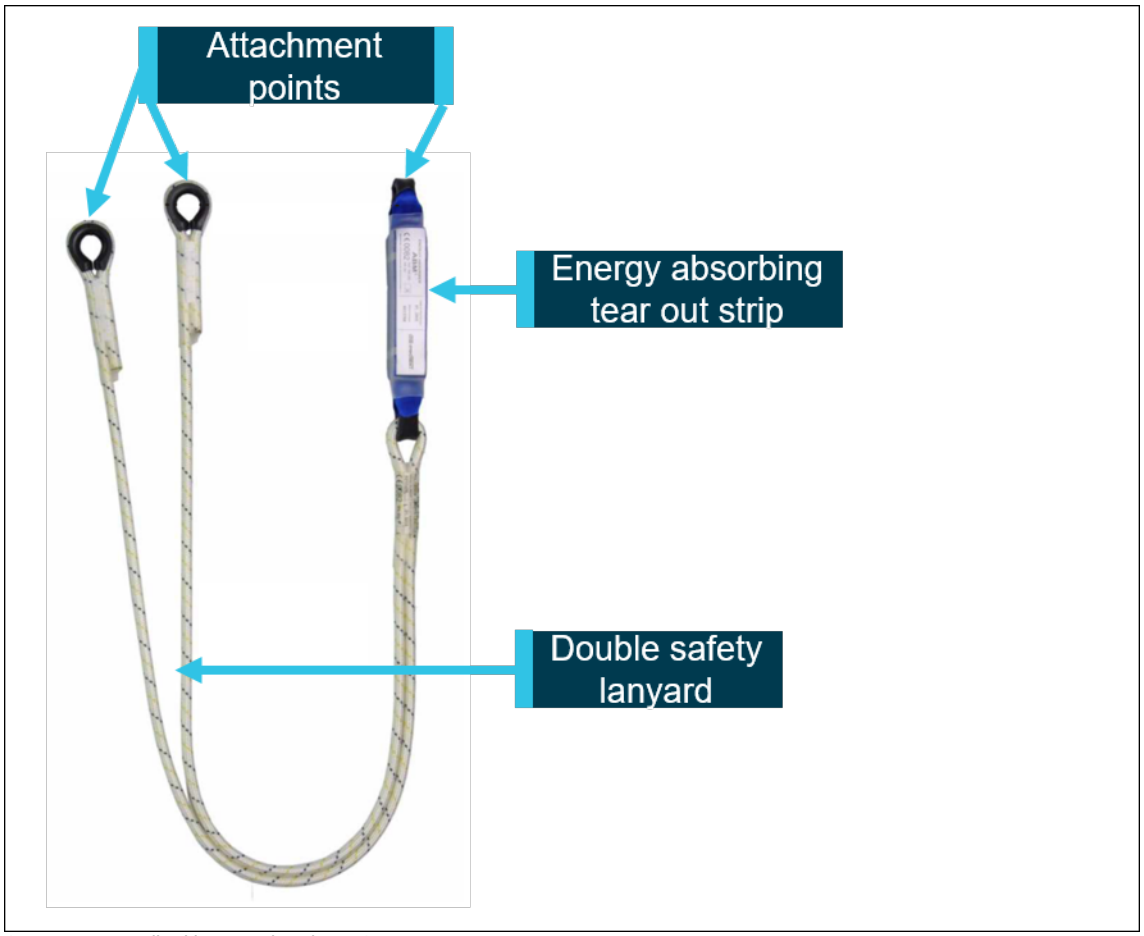
- the appliance should never be operated outside its design limits
- all safety devices as fitted are to be tested for good working order and under no circumstance must the safety devices be isolated or overridden.

However, the lifting appliance was used outside its design limits and with safety devices overridden.

Personal protective equipment usage

Personal protective equipment (PPE) is an essential tool for preventing injury in the workplace. However, to be effective it must be used correctly and as per manufacturer and industry recommendations. For the work aloft on board *Berge Daisetsu*, the risk assessment and PtW had correctly identified that PPE including safety harnesses, safety belts and safety lines was required. The equipment used included a twin-legged energy absorbing fall arrest lanyard. Several of these were on board at the time.

Figure 9: Energy absorbing double lanyard fall arrest equipment in use at the time



Source: Berge Bulk with annotations by ATSB

This type of lanyard[9] comprises a 'Y' configuration – the body of the 'Y' has the tear out energy absorbing component and the two legs have safety lanyards and attachment loops (Figure 9). The energy absorber loop is to be connected to the safety harness of the user and the lanyards are then used for attaching to strong points. One lanyard is attached to one point, and the second can be moved and attached to a second point some distance away. The first can then be disconnected and moved to another point, and so on. This arrangement allows a user to move about a worksite without ever being unhooked from a strong point.

Crane operation

The cargo crane in use at the time of the incident (number 3) served cargo hold numbers 3 and 4. It has a 30 t load capacity and 24 m maximum working radius (at 20° jib angle to the deck). The vertical position of the hook changed by 1,650 mm over the full range of jib angle movement from about 81° to 20° (error in level luffing).[10]

To get the work platform as close to the bulkhead as possible during the painting task required the crane's falling block to be against the coaming. That positioning also limited the fore-aft movement of the hook and platform. To do this however, the crane was required to plumb over the hatch coaming. This was beyond its normal maximum working radius. The working zone luffing limit for the crane was 20°, but to plumb over the hatch coaming the jib needed to be at a lower angle of about 15°. To achieve this, the lower luffing limit of the crane was bypassed. This limit was

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[9] See Work at Height Safety Association (WAHSA) (UK), n.d., *WAHSA Technical Guidance Note (TGN) 02 Guidance on the use of single and twin energy absorbing lanyards*, WAHSA, Shropshire, UK. Available at http://www.wahsa.org.uk/

[10] Level luffing - keeping the hook at a constant level while the crane jib is luffed up or down.

routinely and regularly bypassed to allow the crane jib to be housed. However, operating with the bypass active for any other reason was prohibited.

Prior to this accident, Berge Bulk had identified the need to have specific and approved equipment for working aloft, including work platforms available on its ships. This equipment had already made available on several ships. However, although an approved work platform for *Berge Daisetsu* had been manufactured, it was pending delivery to the ship at the time of the occurrence. Therefore, hold cleaning and touch-up work was limited to those areas that could be reached from the deck.

The company had also identified the need for working aloft in cargo holds and had commenced a process of having new ships fitted with deck cranes approved for personnel lifting in addition to cargo handling.

Safety analysis

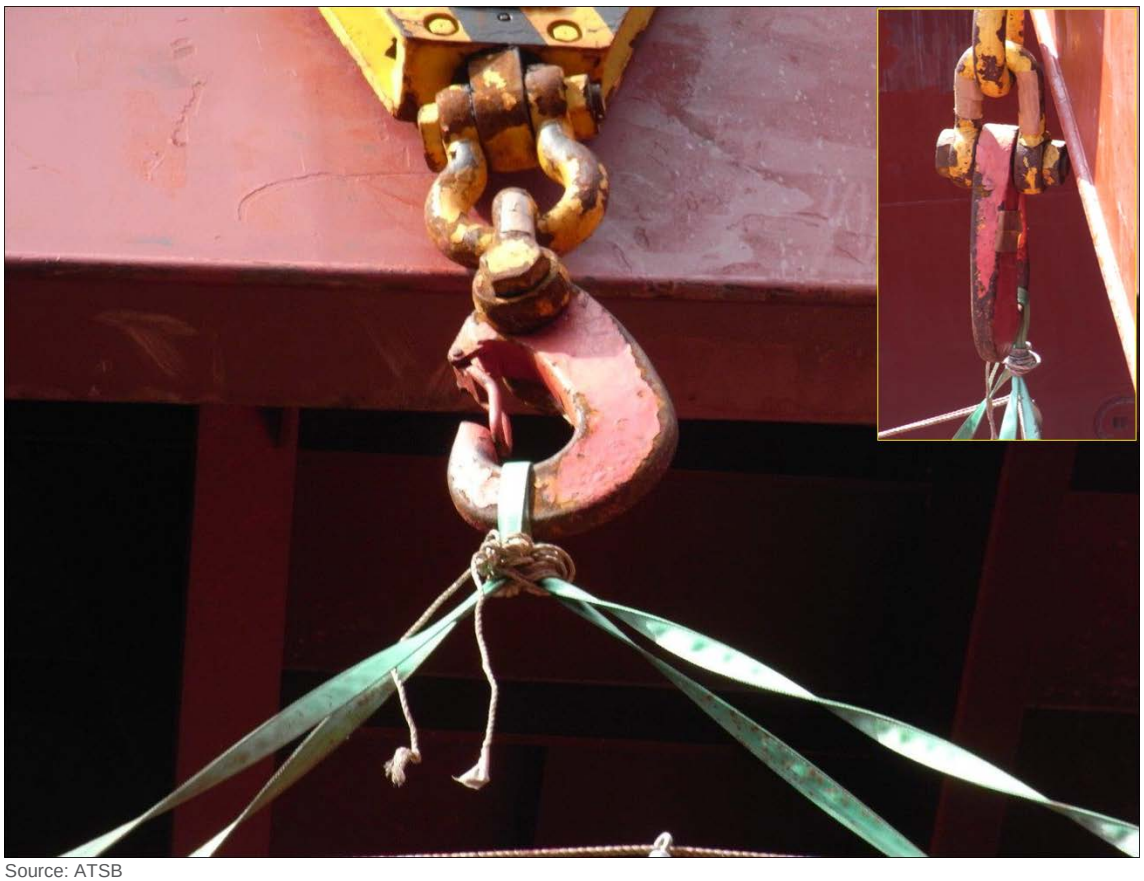
On 11 January 2018, a six-member team was conducting cargo hold cleaning and painting under the supervision of *Berge Daisetsu*'s chief mate. While working aloft, on a jury-rigged platform suspended from a cargo crane, two persons were seriously injured when the crane falling block and hook made contact with the hatch coaming and upset the platform.

This analysis will explore the reasons for the platform upset and examine circumstances around the accident more broadly. This will include consideration of the safety management system and procedures in place for cargo hold painting and working aloft. In addition to this, the knowledge and use of equipment and machinery used for the task will be discussed.

The accident

In a decision probably motivated by efficiency, *Berge Daisetsu*'s crewmembers elected to paint the stained areas of the ship's cargo holds, rather than clean them, in order to meet the requirements to pass inspection and obtain a Certificate of Fitness to Load Grain. While painting the upper areas of the aft bulkhead of cargo hold number 4, the work platform was suspended from number 3 cargo crane with the crane falling block flat against the hatch coaming to position the painters as close as possible to the bulkhead being painted. In this location and orientation, one of the falling block shackle pins protruded fore-aft and extended under the lower edge of the hatch coaming (Figure 10). This presented as a catch point should the hook be lifted vertically.

Figure 10: Crane hook and shackle in approximate position as at time of incident. Inset shows the view from the side with protruding hook shackle pin.



Source: ATSB

To reach this location, the crane's lower luffing limit was bypassed. Bypassing the limit removed control protections from the crane including its level luffing function. Operating the crane in this

mode was prohibited by company procedures, against crane manufacturer advice and contrary to sound working practices.

The need to operate the crane with the limit bypass active was not identified or discussed at any stage during the planning, risk assessment, permit to work or toolbox discussions completed for the job. The bosun regularly drove the cranes and it is likely that he alone was aware that the crane was being operated with the bypass active. However, he was probably unaware of this specific fouling risk when operating with the limit bypassed.

Consequently, when AB2 (on the staging) asked the crane driver (bosun) to raise the jib to access an area to be painted, the falling block rose with the jib. AB2's intent was that the platform would move horizontally and clear of the coaming using the level luffing function of the crane. However, as this function had been bypassed, the jib and falling block moved upwards and this likely led to the protruding hook shackle pin catching under the hatch coaming. As the fouling went unnoticed by the work party, the jib (and hook) continued to move and the shackle pin came free from the hatch coaming with a sudden movement which in turn transferred a significant force to the platform occupants, seriously injuring them.

Safety management system

At the time of the accident, safety management system (SMS) procedures required a risk assessment and a permit to work be completed for the cleaning and painting of the upper areas of the cargo hold. Berge Bulk policy for working aloft agreed with industry guidance in that only suitably designed, approved and certified equipment and machinery should be used for lifting personnel.

On board *Berge Daisetsu*, this task was undertaken using a jury-rigged portable gangway suspended from the cargo-only crane(s) to access the upper areas of the cargo hold(s). The portable gangway was a common piece of ship equipment for use as a means of access to/from the ship and for no other purpose. Additionally, the cranes, though rated to lift 30 t, were not approved for lifting personnel.

Therefore, although the ship's crewmembers had several discussions, made plans and completed a risk assessment in accordance with the SMS requirements, the equipment and machinery use was contrary to company policy and procedures. They were not suitable for the task and their use made hazard identification difficult and exposed the workers to increased risk.

While the decision to adapt on board equipment may have been motivated by a desire to expeditiously prepare the ship for loading, it may also indicate that:

- detailed understanding of the use of machinery and equipment was lacking on board *Berge Daisetsu*
- although the required on board familiarisation included the use of lifting appliances such as cranes, the systems to ensure this knowledge was acquired by users was ineffective.

Furthermore, the risk assessment completed during preparations for the work was not sent ashore for office approval prior to the work being commenced, as required by the SMS. Consequently, shore personnel were unaware that hold painting requiring working aloft was to be done. This removed the opportunity for external scrutiny of the task to determine whether it was necessary and to identify that it involved the use of non-approved equipment and machinery.

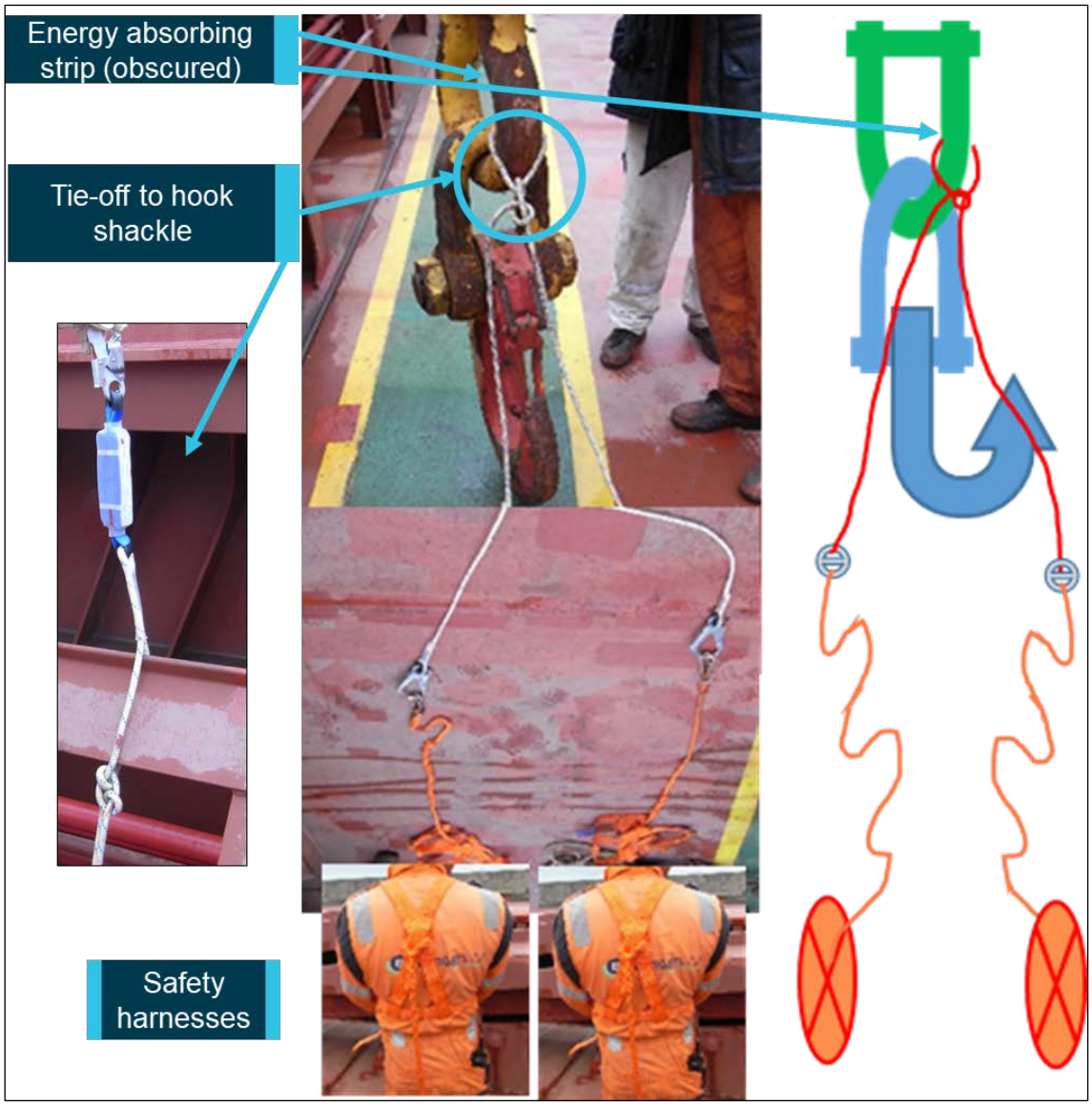
Proactive safety action taken by the company in response to this accident (see the section titled *Safety issues and actions*) included training and assessment of safety culture. The intention of that action was to ascertain whether these identified safety deficiencies were confined to this occurrence or symptomatic of a fleet-wide issue.

Personal protective equipment

During site inspection after the accident, the crewmembers demonstrated how the equipment, including the personnel protective equipment, was being used at the time. During this demonstration it was apparent that the use of the twin legged energy absorbing fall arrest lanyard was not correctly understood. One lanyard was used for both workers (one person attached to each leg), in contrast to the correct usage of one lanyard per person. Furthermore, the energy absorber was excluded from use in the way in which the equipment was attached to the strong point (crane hook shackle). Figure 11 shows how the fall arrest lanyard was rigged.

Had either of the ABs fallen from the work platform, the fall arrest lanyard would not have worked as designed. As the energy absorbing end of the lanyard was incorrectly connected it is possible that the lanyard may have failed completely and the user(s) fallen, unchecked, to the hold bottom.

Figure 11: Composite image and sketch showing how the energy absorbing double lanyard was used and secured



Source: ATSB

The use of safety equipment was discussed during the pre-work toolbox meeting and then on the worksite when all was inspected prior to work commencing. This process involved all crewmembers of the work team including the chief mate. Furthermore, the worksite was checked several times by the master. At no time were any concerns raised about the safety equipment

being used or how it was being used. In particular, the use of a single fall arrest lanyard for two persons when several were available on board was not mentioned.

This suggests that the use of this equipment had not been explained or demonstrated to the ship's complement and/or had been supplied to the ship without any explanatory or usage documentation.

Findings

From the evidence available, the following findings are made with respect to the serious injuries sustained on board *Berge Daisetsu* whilst berthed in Portland, Victoria on 11 January 2018. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance. A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- The suspended painting platform was upset when the hook was moved and suddenly came free from being caught under the hatch coaming. This led to the occupants falling on the platform and receiving serious injuries.
- Contrary to normal operating procedures, the deck crane was being operated with its working limits bypassed when used to support the ship's crew during the painting task. This enabled the crane to reach a position which allowed the block to be in contact with and catch on the hatch coaming.
- The task was not conducted in accordance with company safety management procedures or industry best practice with regard to risk management and working aloft permit requirements. Consequently, machinery and equipment were used in a way they were not designed or approved for, making hazard identification difficult and exposing the workers to increased risk.

Other factors that increased risk

- **The fall arrest equipment used was incorrectly attached to the workers on the suspended platform. Consequently, had either of them fallen from the platform the equipment would not have worked correctly, resulting in serious or fatal injuries. [Safety issue]**

Safety issues and actions

The safety issue identified during this investigation is listed in the Findings and Safety issues and actions sections of this report. The ATSB expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the marine industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

All of the directly involved parties were provided with a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

The initial public version of these safety issues and actions are repeated separately on the ATSB website to facilitate monitoring by interested parties. Where relevant the safety issues and actions will be updated on the ATSB website as information comes to hand.

Knowledge and use of fall arrest safety equipment

Number:	MO-2018-001-SI-01
Issue owner:	Berge Bulk Maritime
Operation affected:	Marine: shipboard operations
Who it affects:	All workers on ships

Safety issue description:

The fall arrest equipment used was incorrectly attached to the workers on the suspended platform. Consequently, had either of them fallen from the platform the equipment would not have worked correctly, resulting in serious or fatal injuries.

Proactive safety action taken by Berge Bulk Maritime

Action number: MO-2018-001-NSA-003

Berge Bulk Maritime has advised the ATSB that it has taken the following actions to address this issue:

- completed on board working aloft training of all staff
- completed on board training in bulk carrier personal safety and environmental protection including working safely in cargo holds and the correct donning and use of personal protective equipment
- added a mandatory working aloft training module to fleet-wide on board training programmes, which is repeated every two years. This programme includes modules on working aloft risk identification, safe access at height and safe methods of work at height.

Status of the safety issue

Issue status: Adequately addressed

Justification: The safety actions taken by Berge Bulk Maritime will significantly reduce the likelihood of a similar future occurrence.

The training, equipment and machinery changes implemented and progressing should greatly reduce the likelihood of similar issues with working aloft and appropriate use of PPE in the future.

Additional safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence

Berge Bulk Maritime advised the ATSB that it has also taken the following actions as a result of this incident:

- completed the fleet-wide purchase and supply of Class-approved work platforms for work aloft to all company-owned geared bulk carriers
- commenced a programme to have all fleet geared bulk carriers' cranes modified and approved for personnel lifting at scheduled dry dockings
- engaged an external consulting company to conduct a fleet-wide assessment of safety maturity by measuring the company's level of safety practice and how well this is embedded in the behaviour and belief of employees. This assessment is intended to assist the development and implementation of an integrated company-wide safety strategy.

General details

Occurrence details

Date and time:	11 January 2018 – 1510 EDT	
Occurrence category:	Serious incident	
Primary occurrence type:	Serious injury	
Location:	Portland, Victoria	
	Latitude: 38° 21.1’ S	Longitude: 141° 37.2’ E

Ship details

Name:	*Berge Daisetsu*
IMO number:	9713179
Call sign:	2IPO5
Flag:	Isle of Man
Classification society:	DNV-GL
Ship type:	Geared log / bulk carrier
Builder:	The Hakodate Dock Co. Ltd, Hokkaido, Japan
Year built:	2015
Owner(s):	Berge Daisetsu Company Inc. (Marshall Islands)
Manager:	Berge Bulk Shipping Pty. Ltd. (Singapore)
Gross tonnage:	21,530
Deadweight (summer):	34,533 t
Summer draught:	9.822 m
Length overall:	179.97 m
Moulded breadth:	30.00 m
Moulded depth:	14.05 m
Main engine(s):	Mitsubishi 6UEC45LSE-Eco-B2
Total power:	5,690 kW at 108 rpm
Speed:	14.0 knots
Damage:	Nil

Sources and submissions

Sources of information

The sources of information during the investigation included:

- the master and crewmembers of *Berge Daisetsu*
- Berge Bulk Maritime
- Mitsubishi Heavy Industries
- DNV GL
- the Australian Maritime Safety Authority
- the Isle of Man Ship Registry.

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Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the master, chief mate, bosun, 3 able seamen, ordinary seaman and deck cadet from *Berge Daisetsu*, Berge Bulk Maritime, the Australian Maritime Safety Authority and the Isle of Man Ship Registry.

Submissions were received from Berge Bulk Maritime, the Australian Maritime Safety Authority and the Isle of Man Ship Registry. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The ATSB is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Terminology used in this report

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing factor: a factor that, had it not occurred or existed at the time of an occurrence, then either:

(a) the occurrence would probably not have occurred; or

(b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or

(c) another contributing factor would probably not have occurred or existed.

Other factors that increased risk: a safety factor identified during an occurrence investigation, which did not meet the definition of contributing factor but was still considered to be important to communicate in an investigation report in the interest of improved transport safety.

Other findings: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which ‘saved the day’ or played an important role in reducing the risk associated with an occurrence.